

PS/2 Mouse ISA Card / Serial port emulator for the 8-bit ISA bus

Adapter rev1.0 by RiO444 (c)2019

Guide v1.3 by jaZz_KCS

Info: All driver downloads mentioned in this guide are also packed withing the zip alongside this guide.

1. Purpose

The PS/2 port was first introduced by IBM in the late 80s as a ways and means to add another HID port for their PS/2 systems (which gave the port its famous name.) Interestingly, as the PS/2 port was directly hooked via interrupt into the system bus, it enjoyed a rather long utilization (until 2010+), after originally succeeding the AT keyboard port it was the only way to use a mouse/keyboard on a hardware level (for example in the BIOS) and with low latency for a long time, until USB took over this capability.

Before the arrival of the PS/2 port (and it de facto becoming the standard for mouse and keyboard connectors), serial mice were the norm. These were usually "ball mice", with the exception of rather rare optical mice that made use of special reflective mouse pads, which usually had a rather poor resolution.

The purpose of this adapter card is to provide systems from before the PS/2 era (or systems lacking a PS/2 port altogether) with a fully working PS/2 mouse port. Not only are serial mice getting more and more rare with every passing day, but PS/2 mice are also still abundantly available to this day. This would also eliminate the need of a serial mouse on your desktop just for that one machine that might need one as it doesn't support PS/2.

2. General principles of the adapter

When it comes to programs utilizing the mouse, this adapter is seen as a genuine serial card with a COM port. There are some minor differences compared to a generic multiscard or the system's own COM ports, however:

- The adapter emulates the 8250 chip, which is a serial controller of older design. Unlike its newer successor (the de facto standard 16550 chip), the 8250 does not feature a "transmit and receive buffer" for several bytes (FIFO buffer). Not to worry, as for mouse usage this buffer is unnecessary, as the received data is always immediately processed (byte-by-byte). And in ordinary operation mode, the mouse only transfers data, and does not receive any.
- The firmware of the adapter card does not support a diagnostic ("Loop") mode. This is a deliberate simplification. A firmware capable of "Loop" mode would require a more complex Altera chip (EPM3128 instead EPM3064). This would make the adapter more complex and more expensive, but would not affect its functionality. (This mode is usually ignored by drivers and operating systems themselves and usually only necessary for mouse diagnostic tools.)

Info: The part of the adapter that interacts with the ISA bus (containing the registers and allowing the CPU to read and write to them) is the CPLD Altera EPM3064 (in the photo on the left, the large chip).

Interaction with the mouse itself and the conversion of data formats is performed by the Atmega8A micro controller (in the photo on the right, the small chip).

3. Advantages of the adapter compared to existing PS/2-to-Serial mouse converters.

There exist a multitude of PS/2-to-Serial adapters out there which all seem to transmit data from the PS/2 mouse through the Serial port at a speed of 1200 baud (a maximum of 44 data packets per second). Due to this slow speed the data is not transmitted synchronously, rather one packet sent accounts for 2-5 packets received from the mouse. The number of received packets from the mouse differs a lot and is usually fractional.

This added delay, as well as the inconsistencies due to the number of returned packets can be subjectively felt as being not as smooth compared to a genuine PS/2 mouse connected to a PS/2 port directly. The 8-bit ISA PS/2 Mouse Adapter card eliminates these inconsistencies.

Not only is the data transfer consistent, but it also feels as if there is no adapter present at all. This is achieved by:

- Higher transfer speed.

The ISA bus operates at a frequency of 8 MHz. (One byte (8 bits) is transmitted in several clock cycles.) The processor itself introduces more delays, as it needs to free itself from running the current program in order to handle the interrupt from the adapter. Inside the adapter - between the Altera and Atmega chips - the transmission is achieved via a serial interface, with speeds of megabits per second.

- Synchronous data transmission

The data is transmitted synchronously and with minimal conversions, as each data packet received from the mouse is immediately transferred to the computer. The transformations are caused only by the difference in the formats of mouse movements along the X and Y axis.

Info: For PS/2 mice, the range along the X axis from -256 to 255 is cut to the range -128 ... 127 COM of the mouse, along the Y axis from -256 to 255 it is cut to 127 ... -128 (the direction is inverted). But in practice, these limitations are not felt in any way, as data is transmitted 2 to 5 times more often than from a serial mouse.

4. System compatibility

The adapter has already been successfully tested on systems of a wide range, spanning all the way from a 8Mhz "deturbo'd" 286 to a Pentium III-S 1400, including 386, 486 and Pentium/MMX machines. There also exist positive reviews about the adapter working on XT machines, although you will probably have to select the appropriate driver and configure the adapter using the provided jumpers.

Tests have been successfully conducted with several Operating Systems:

- MS-DOS 6.22 (with more than 5 individual mouse drivers)
- Windows 3.1/3.11, 95/98, NT3.51/4.0
- Linux Slackware 3.5 Live-CD

The adapter does not work on Windows XP due to reasons currently unknown.

At this moment (2019/10/21), only one (minor) incompatibility is known:

- Motherboards featuring WinBIOS and built-in Serial ports.

Despite disabling them in the BIOS, Windows still enables and initializes the Serial ports in question. After disabling the system's own Serial ports inside Windows itself though, the adapter works.

5. Mouse operation and USB-to-PS/2 adapter compatibility

A PS/2 mouse itself not working on the adapter card has yet to be found. If you do own a PS/2 mouse that apparently seems incompatible with the adapter card, please get in contact.

As for USB->PS/2 adapters: The compatibility depends upon the mouse in question. Generally, if the mouse is double-standard and is capable of working with a USB->PS/2 adapter, it will work with the adapter. If your USB mouse originally has been sold together with a PS/2 adapter, you can be 99% sure it will work with the adapter card. If there were two versions sold, USB and PS/2, then chances of it working on the adapter card are still very high. If the mouse in question was only sold as a USB version, chances are slim.

Below is a list of mice tested and working with the adapter:

- PS/2 A4 TECH OP-629D (99)
- PS/2 Genius NetScroll 110 (77)
- PS/2 Defender Optimum MB-150 (107)
- PS/2 ballpoint Genius NetScroll + (120)
- PS/2 SVEN RX-112 (173)
- USB SVEN RX-112 (106)
- USB Defender (without nameplate) laser gaming (114...129)
- USB Perfeo PF-81 (cheap, for laptop) (213)
- PS/2 ballpoint Microsoft 2.1A (two-button) (102)

The number at the end of each line in brackets is the speed at which the mouse transmits data when working in the adapter (number of data packets per second.) The default should be 100 (the adapter gives the mouse exactly this speed). As one can see, a rather large spectrum is obtained from these models (77-213). This is why there exists the possibility to change the speed of the adapter with the help of jumpers (see Section 7 below)

6. LED behaviour explained

The LED should light up 1-2 seconds after turning on the computer.

If the LED lights up, it means:

- Power is supplied to the adapter
- PS/2 mouse is detected by the adapter.

If the LED does not light up, there can be multiple reasons:

- Lack of power on the adapter (it feeds off the 5V ISA rail), check ISA slots / planar
- No mouse detected (no connection), check cable and connectors
- Mouse in question is broken and/or not compatible

Please be aware that after initially starting the system and the LED turning on (if everything is working o.k., indicating a detected PS/2 mouse and power input), after the mouse driver is successfully loaded, the LED goes off again. (!) (see below)

The driver can be either launched separately (under DOS) or embedded in the OS (Windows 3.11, 9x, ...).

The reason for the LED turning off again after the successful driver load is that it now works as a data transfer indicator, blinking alongside every interaction with the mouse (button press and axis movement)

!! Caution: !! Although it is very hard to damage the adapter card itself, not every mouse supports hot-plugging. Theoretically you are now able - after successful initialization and driver load - to unload the driver again and plug in another mouse on the fly (hot-plugging) and then load the driver again. Note that not every mouse supports this and there are even some models that will get [fatally] damaged by doing this.

7. Installation and configuration

!! Before installing the adapter, you must free the multcard's / system's own COM1 port (or COM2 or COM3, respectively.) !!

The standard address for COM1 is located at 3F8. (for COM2 and COM3 - at 2F8 and 3E8, respectively).

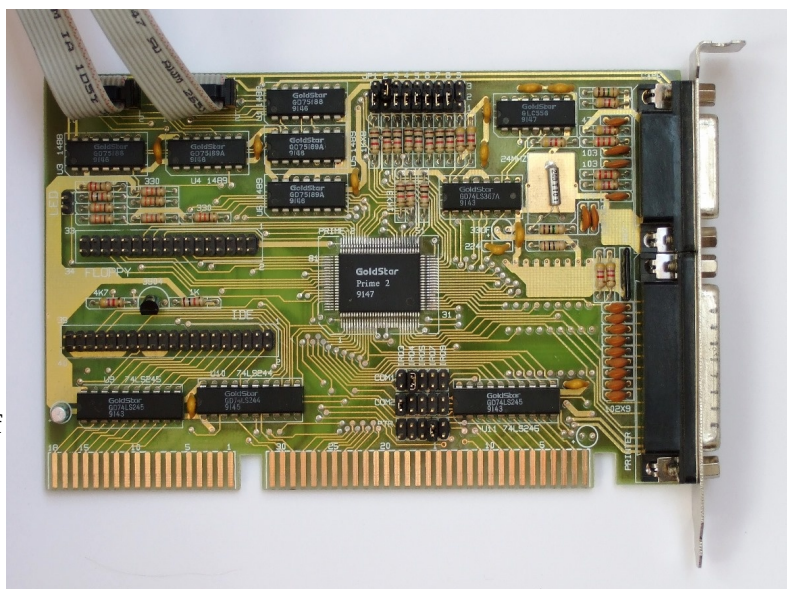
The easiest way to free up this resource is by simply disabling the COM1 port with the jumpers on your respective multcard or - when not using a multcard - within the settings of your BIOS.

Method I - Multicard

Here is an example of a multicard:

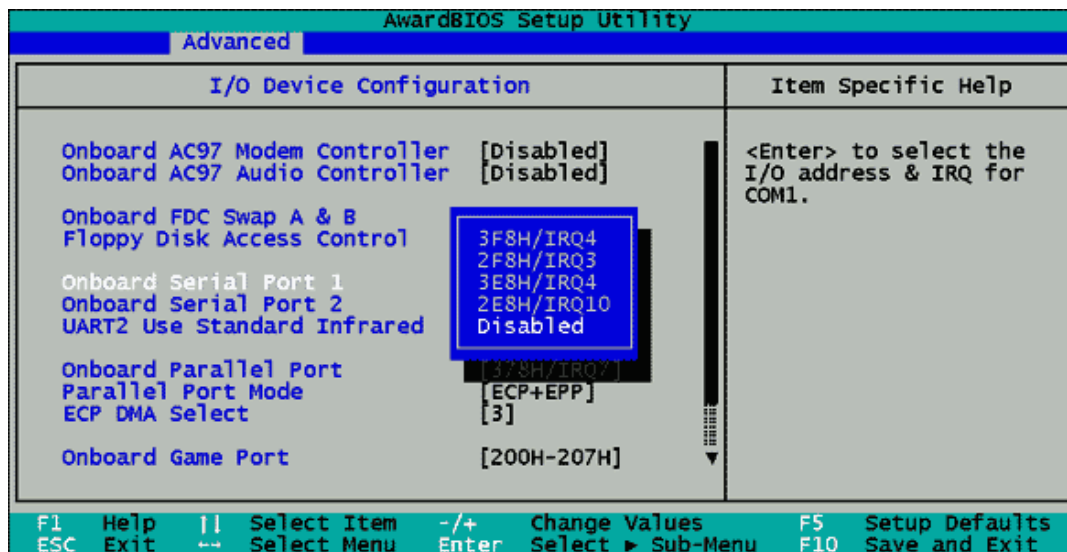
According to the manual of this multicard -

(<https://stason.org/TULARC/pc/hard-disk-floppy-controllers/U-Z/UNIDENTIFIED-Two-IDE-AT-drives-IDE-PLUS-V3.html>) - in order to disable COM1, jumper JP2 has to be closed/present in position 2-3 (already arranged in the photo above.) **!! You will have to proceed according to your multicard's manual to disable COM1 on your multicard, if you are using one !!**



Method II - Integrated Serial ports

Obviously, when the Serial ports are integrated into your motherboard, it makes it easier. Simply find the option in your BIOS that disables your first Serial port. (COM1) (Example shown below)



Info: There is another way to free up the resources for COM1 - by changing its address from 3F8 to 3E8 - essentially turning it into COM3 (as most Operating Systems interpret a Serial port on that address normally as COM3.) (For the above multcards, this is done with the JP6 jumper (closing jumper 2-3).

In the BIOS, instead of disabling COM1, set it to use resources "3E8/IRQ4" instead. This method is not beneficial however, as it renders COM 3 useless, if COM1 is in use. It makes it impossible for a second serial device to be used simultaneously on COM 3 (if for example there is already a mouse present on COM1), as only one serial device can occupy one Interrupt at any given time. (in this case IRQ4)

After you have made sure that the resources for COM1 are now freed up, you can now safely install the adapter in any of your free 8-bit or 16-bit ISA slots.

Generally, the adapter works with any generic drivers for serial mice.

For **DOS**, at least 5 drivers have been successfully tested (from mouse.com to CuteMouse). There is a great variety of these drivers available, whereas CuteMouse is definitely recommended due to its elaborate choice of possible settings to change if need be and general compatibility..

In **Windows 3.1/3.1/NT**, you will have to set the driver and port manually within Windows Setup. Set it to COM1, and resources 3F8/IRQ4. (2F8/IRQ3 for COM2, and 3E8/IRQ4 for COM3 respectively, if you have changed the card's default values via jumpers (see Section 7 below)) The model of the mouse used should be set to either "Microsoft Serial Mouse", "Microsoft or IBM PS/2 Mouse" (the one not mentioning "serial"), or "Logitech Mouse". Try the Microsoft ones first, treating the "Logitech Mouse" as a last resort.

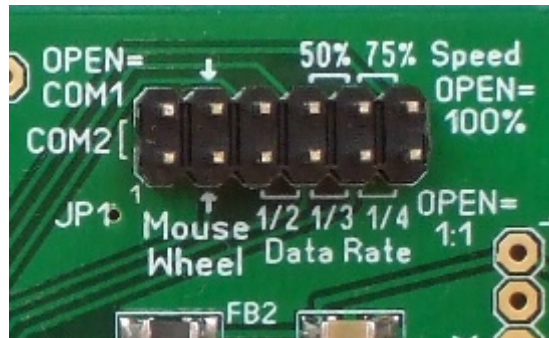
In **Windows 95**, you may need to "Add new hardware" from within the Control Panel if your mouse is not being picked up automatically.

In **Windows 98/NT4**, all tests indicate it being detected automatically and no further steps are required.

Info: A small selection of DOS mouse drivers may be obtained from http://64hdb.mine.nu/mIRROR/PS2SPE/Mouse_Drivers.zip

7.1. Changing the default settings / Jumper explanation

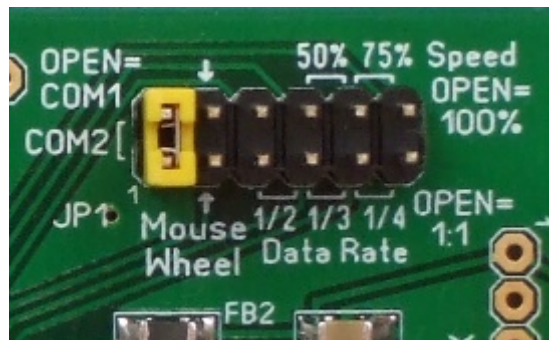
By default, the adapter card does not have *any* jumpers set. This is the default configuration. Any jumpers added to the adapter card indicate that some settings have been changed from their defaults. Please see below for a full list of custom settings.



Jumper 1-2 - COM port selection

This jumper selects the desired COM port.

- If removed/open (default), the adapter is seen by the system as port COM1.
- If present/closed, the adapter is seen by the system as port COM2 (2F8/IRQ3). In this case - as you might have guessed - it is necessary to disable the COM2 port on the motherboard or multocard instead.



This should work exactly as choosing COM1, as all generic serial mouse drivers and Operating Systems of that era are looking for a mouse on *both* COM1 and COM2.

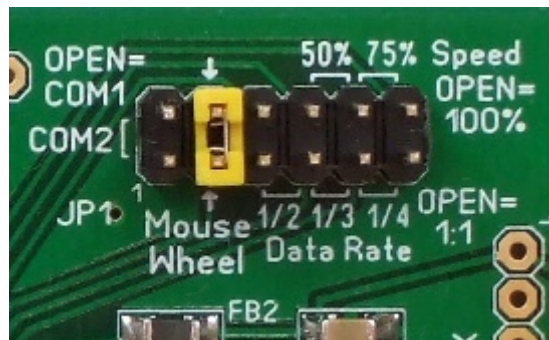
Changing the state of this jumper has an effect only *after* rebooting the computer. With some motherboards, a "warm" start is sufficient (CTRL-ALT-DEL) ("Restart the computer" in Windows), but some require a "cold" reset (press "Reset" button or turn off/on the computer.)

The indicator of a successful reboot is the glowing LED on the adapter card (which vanishes again, and reappears as an input indicator after successful driver load.)

Jumper 3-4 - Enable mouse wheel function

This jumper enables the mouse wheel.

- If removed/open (default), the mouse wheel function is disabled.
- If present/closed, the mouse wheel function is enabled.



When this jumper setting is has been changed, its changes will only apply after successful re-initialization of the mouse. To do this, either restart the adapter (reboot the computer), or unload the mouse driver (which is for example possible under DOS when using CuteMouse), move the mouse (so that the LED on the adapter lights up again). After that, you can reload the driver again and the settings should have been applied.

This setting only works if the connected mouse indeed has a wheel. Usually, all drivers for 2-button mice are suitable. If you use driver for a 3-button mouse however (i.e. Logitech), the driver either won't start, or the third button will be inoperable. In **DOS**, the wheel is known to be supported at least by CuteMouse. **Windows 98** and **NT** pick up the wheel automatically.

Windows 95 might need customizations. You may need to change the mouse model to one that actually features a wheel or try this driver instead (recommended) -->

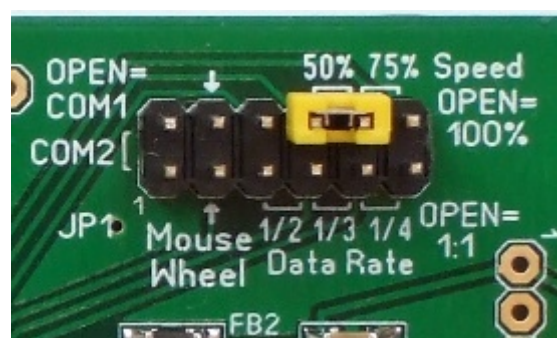
<http://64hdb.mine.nu/mIRROR/PS2SPE/msip20a.zip> (It is installed by running setup.exe.)

!! But do this only after the mouse already works correctly (without the wheel) with the standard "Microsoft Serial Mouse" driver, and the adapter is present in the device manager list as "COM1" (or "COM2/3" if you changed the default settings of the card) !!

Jumpers 8->12 - Cursor speed select

These jumpers will let you choose different speed settings:

- Jumper 8-10 closed/present will set the cursor speed to 50%
- Jumper 10-12 closed/present will set the cursor speed to 75%
- Leaving all jumpers (8-10-12) open will set the speed to 100% (default)



These jumpers all work in real time. If you changed the position of the jumper during full operation of the adapter card (the mouse is connected and the driver is loaded), you will immediately see the results.

Info: Due to differences between the PS/2 and COM interfaces and the direct transfer of mouse movements, the cursor moves slightly faster compared to usual Serial and PS/2 mice.

Of course, you can also **reduce the speed using the driver** of your current Operating System, which is the preferred method. (Explanation below)

In **Win 95/98** and **NT 4.0** - in the properties of the mouse, for example. Many drivers for **DOS** also allow it by using command line parameters (options). For CuteMouse, this is the option **"/R"**. (see example on the right)

```
C:\DRU>ctmouse.exe /?
CuteMouse v2.1 beta4 [FreeDOS]

Options:
/V - reverse search: find PS/2 after serial mouse
/P - force PS/2 mouse mode, do not probe serial ports
/S[c[i]] - force serial mouse mode at COM port c (1-4) with IRQ i (1-7)
/3 - force 3-button mode if Microsoft or PS/2 mouse found
/O - enable PS2 and BIOS USB wheel detection (might hang)
/M - try *old* Mouse Systems / Genius for non-PnP mice

/R[h[v]] - horizontal / vertical resolution: h,v = 1-9, or 0 for auto
          (no value = use default: auto for h, or "as h" for v)
/L - swap left and right button

/B - cancel run if mouse services are already present
/N - load CuteMouse as new TSR, even if CuteMouse is already loaded
    (useful for batch files which unload CuteMouse at end)
/W - do not allow CuteMouse to move itself into UMB
/U - uninstall driver, remove TSR from memory
/? - show this help

C:\DRU>
```

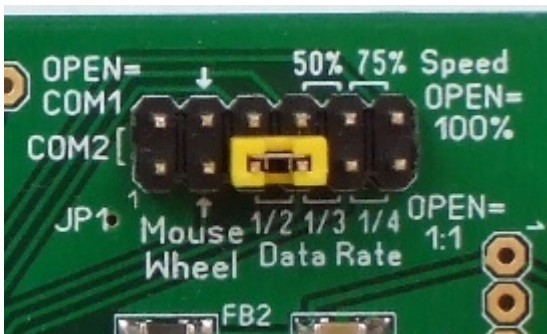
If none of these methods suits you, you can adjust the speed using the adapter's jumper settings as described above.

!! However it is worthy of note that the slowdown by means of the driver (or the Operating System) is more accurate, and therefore, preferable. Due to the characteristics of the COM port, the adapter rounds off movements to integers, which introduces a rounding error. !!

Jumpers 5->11 - Reduce data transmission frequency

These jumpers let you choose different data transmission speeds:

- Jumper 5-7 closed/present decreases the speed by 2x
- Jumper 7-9 closed/present decreases the speed by 3x
- Jumper 9-11 closed/present decreases the speed by 4x
- Leaving all jumpers open will result in the fastest speed (1x) (default)



These jumpers all work in real time. If you changed the position of the jumper during full operation of the adapter card (the mouse is connected and the driver is loaded), you will immediately see the results.

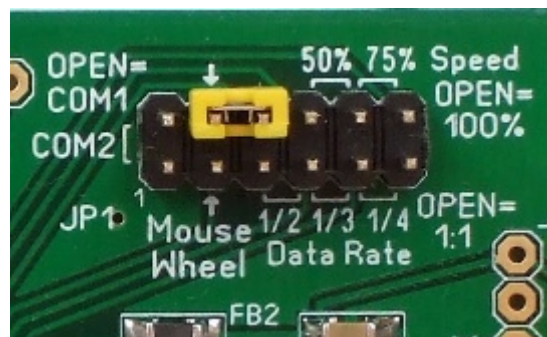


Decreasing the data transmission speed can offload your processor. If you set the frequency reduction to 2x, not every packet of data (mouse movements) received from the PS/2 mouse will be transmitted to the processor, but the sum of the last two packets. That is, two movements are added up and their total amount is transmitted. Accordingly, at a frequency of 1/3 this will be the sum of the last 3 packets, at a frequency of 1/4 it will be the sum of the last 4 packets.

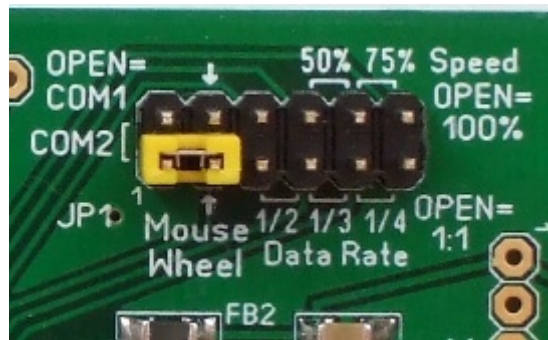
Info: Why would you want to decrease the transmission speed? As noted above, this can offload your processor. Data from the PS/2 mouse is transmitted synchronously by the card adapter. That means each data packet from the mouse is immediately transferred to the computer without delay. But there exist faster PS/2 mice than normal (sending the data over 200 times a second, instead of the usual 100 times). This can put a significant load onto older computers (below 286). In this case, decreasing the data transmission speed can offload the processor. The downside is a decrease in mouse responsiveness, albeit button presses and wheel scrolling are still transmitted synchronously. They are not slowed down.

7.1b. Undocumented feature - COM3

For those in need due to any reason, there exists the possibility to set the adapter card to COM 3. This is not recommended however, as the vast majority of driver software of the older kind will be looking for a mouse specifically on COM1 and COM2. (example: Windows 3.1/3.11)
Set the jumpers accordingly to the picture below:



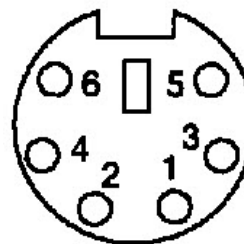
If you have set the adapter to use COM3, you can enable the wheel as follows:



8. Reasons for connectors XS1, XS2 and XS3 not being soldered onto the board.

The XS1 and XS2 connectors are used for in-circuit programming of Atmel Atmega8 and Altera EPM3064 chips. they are first and foremost needed for debugging the device. Therefore, in the finished product, these connectors will not be soldered.

The XS3 connector actually allows you to connect an external bracket with a PS/2 connector, like pictured below:



Pinout on Female Port

<i>Pin Number</i>	<i>Description</i>
1	Data
2	No Connection
3	Ground
4	+5V
5	Clock
6	No Connection

The pinout is the same as on the main connector.

Only in the XS3 connector has the pads arranged in order (1-2-3-4-5) and there is no contact 6.